

Two new spinocyrtiid brachiopods (Spiriferida) from the Pragian and the Lower Emsian of Belgium

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Abstract

Two new species of spinocyrtiid brachiopods, *Tenuicostella similis* n. sp. and *Tenuicostella vicina* n. sp. are described. They are present in the La Roche (Upper Pragian) and Pesche (Lower Emsian) Formations. These new Belgian species are compared to the German species *Tenuicostella tenuicosta* (SCUPIN, 1900), *Subcuspidella? humilis* (SCUPIN, 1900), *Spirifer subcuspidatus* var. *depressa* FUCHS, 1909 and *Spirifer incertus* FUCHS, 1909. For *Spirifer incertus* FUCHS, 1909 (non *Spirifer incertus* HALL, 1858) a new name, *Spirifer incertissimus* n. nom., is proposed; the characteristics of the species are briefly discussed. The knowledge of *Subcuspidella beugniesi* GODEFROID, 2001 is completed by comparing this species to *Subcuspidella? montana* (SPRIESTERSBACH, 1925).

Key-words: Brachiopods. Spiriferida. Spinocyrtiidae. Pragian. Emsian. Belgium.

Résumé

Deux nouvelles espèces de brachiopodes Spinocyrtiidae, *Tenuicostella similis* n. sp. et *Tenuicostella vicina* n. sp. sont décrites. Elles sont présentes dans les Formations de La Roche (Pragien supérieur) et de Pesche (Emsien inférieur). Ces deux nouvelles espèces belges sont comparées avec les espèces allemandes *Tenuicostella tenuicosta* (SCUPIN, 1900), *Subcuspidella? humilis* (SCUPIN, 1900), *Spirifer subcuspidatus* var. *depressa* FUCHS, 1909 et *Spirifer incertus* FUCHS, 1909. Un nouveau nom, *Spirifer incertissimus* n. nom., est proposé pour *Spirifer incertus* FUCHS, 1909 (non *Spirifer incertus* HALL, 1858); les caractéristiques de l'espèce sont brièvement discutées. La connaissance de *Subcuspidella beugniesi* GODEFROID, 2001 est complétée par la comparaison de cette espèce avec *Subcuspidella? montana* (SPRIESTERSBACH, 1925).

Mots-clefs: Brachiopodes. Spiriferida. Spinocyrtiidae. Praguien. Emsien. Belgique.

Kurzfassung

Zwei neue Arten spinocyrtiider Brachiopoden werden beschrieben: *Tenuicostella similis* n. sp. und *Tenuicostella vicina* n. sp. Sie kommen in der La Roche-Formation (Oberes Pragian) und in der Pesche-Formation (Unteres Emsium) vor. Die neuen belgischen Arten werden

mit den deutschen Arten *Tenuicostella tenuicosta* (SCUPIN, 1900), *Subcuspidella? humilis* (SCUPIN, 1900), *Spirifer subcuspidatus* var. *depressa* FUCHS, 1909 und *Spirifer incertus* FUCHS, 1909 verglichen. Für *Spirifer incertus* FUCHS, 1909 (non *Spirifer incertus* HALL, 1858) wird ein neuer Name vorgeschlagen: *Spirifer incertissimus* n. nom.; die Merkmale dieser Art werden kurz erörtert. Der Kenntnisstand von *Subcuspidella beugniesi* GODEFROID, 2001 wird vervollständigt durch einen Vergleich dieser Art mit *Subcuspidella? montana* (SPRIESTERSBACH, 1925).

Schlüsselwörter: Brachiopoden. Spiriferida. Spinocyrtiidae. Pragian. Emsium. Belgien.

Introduction

Spinocyrtiid brachiopods are rather abundant (but unfortunately most of them are deformed!) in the Pragian and Emsian Formations of Belgium. In a previous publication, one of us (GODEFROID, 2001) has undertaken the revision of this group by describing three new species, *Tenuicostella dumonti* GODEFROID, 2001, *Subcuspidella asselberghsi* GODEFROID, 2001, *S. beugniesi* GODEFROID, 2001 and a fourth one determined *S. cf. subcuspidata* (SCHNUR, 1851). We are continuing this work of revision with the description of two new species, *Tenuicostella similis* n. sp. and *T. vicina* n. sp., present in the Pragian La Roche Formation and the Lower Emsian Pesche Formation.

The available material is composed of internal casts of isolated valves, rare articulated specimens (internal casts) and partly preserved external casts of which the bulk was collected by two (J. G., P. S.) of us in the Couvin and Grupont areas (Fig. 1) during bed by bed geological surveys. It was supplemented by specimens of the old collections of the "Institut royal des Sciences naturelles de Belgique". Except for two specimens being part of the collections of the Institute, German material studied and/or illustrated for comparison and discussion has been collected by one (G. T.) of us in the Oberstadtfeld area (Germany) or is part of the collections of the "Institut für Paläontologie, Museum für Naturkunde der Humboldt-Universität" (MB.B.) at Berlin or of the "Institut für Paläontologie, Rheinische Friedrich-Wilhelms Universität" at Bonn.

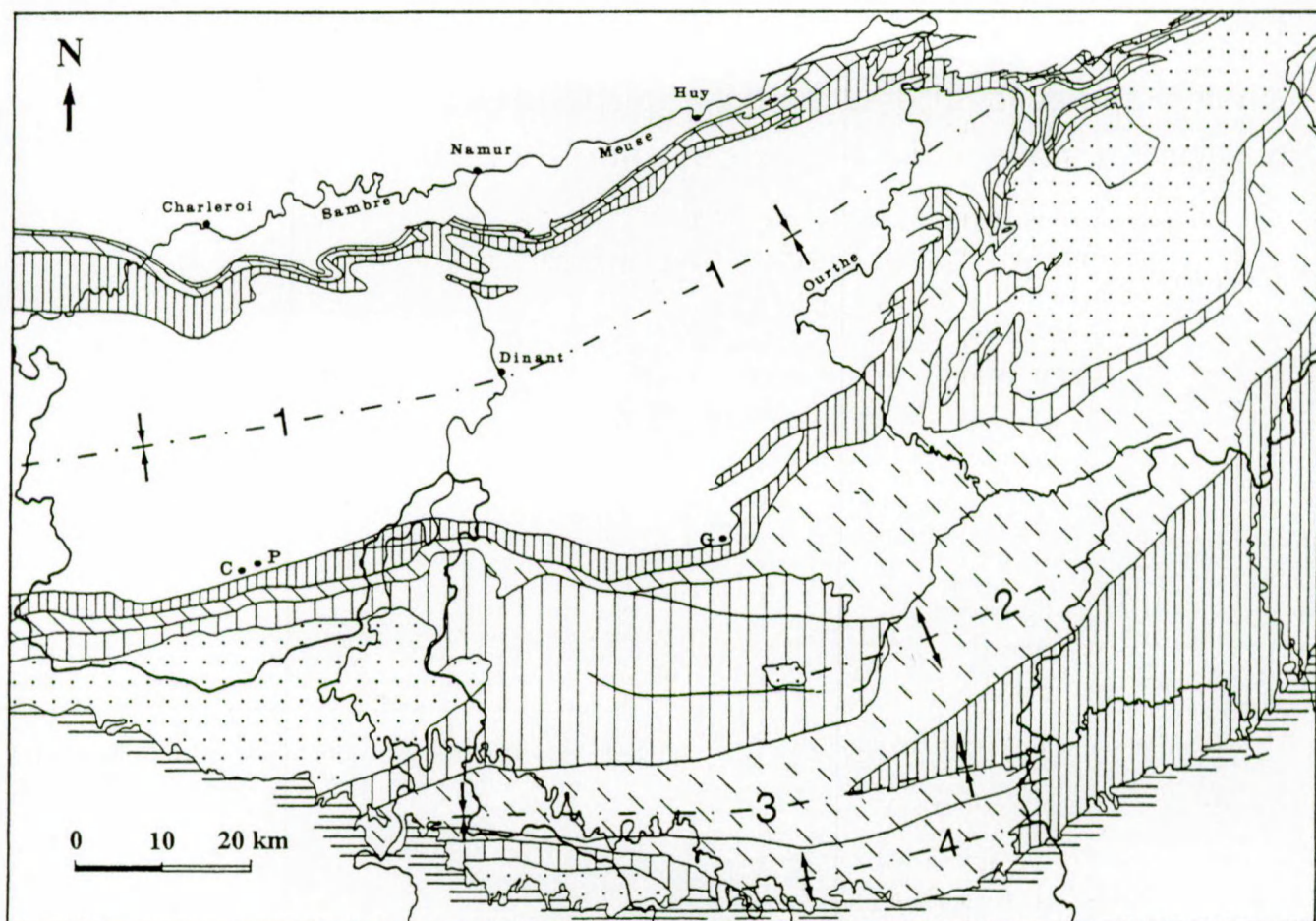


Fig. 1 — Schematic geological map of southern Belgium with location of the fossiliferous localities.

Symbols: stippling = Cambrian and Cambro-Ordovician massifs; wide vertical hatching = Lochkovian ("Gedinnian") formations; oblique hatching = Pragian ("Siegenian") formations; close vertical hatching = Emsian formations; horizontal hatching = Mesozoic formations.

Abbreviations: 1 = axe of the Dinant Synclinorium; 2 = axe of the Ardenne Anticlinorium; 3 = axe of the Neufchâteau Synclinorium; 4 = axe of the Givonne Anticlinorium; C = Couvin; P = Petigny; G = Grupont.

Types and illustrated specimens stored in the collections of the "Institut royal des Sciences naturelles" at Brussels are numbered IRScNB a11684-a11721.

Stratigraphy

THE LITHOSTRATIGRAPHICAL UNITS

The La Roche and Pesche Formations in which the new species have been collected are described in GODEFROID *et al.* (1994, pp. 53-66). The bases of the Pragian and of the Emsian in Belgium are discussed in BULTYNCK *et al.* (2000, pp. 93-97).

THE OUTCROPS

Topographic map 1:25.000 Chimay - Couvin 57/7-8

- Outcrop JG-1972-1: The outcrop has been described formerly (e.g. GODEFROID, 1979; GODEFROID *et al.*, 1994, figs. PER/PES- 1-5). The formations named A

and B in the first publication correspond respectively to the La Roche and Pernelle Formations.

- Outcrop JG-1973-1: A short description of this outcrop which belongs to the La Roche Formation (formerly Formation A) is given by GODEFROID (1980, p. 8, fig. 2).

Topographic map 1:25.000 Grupont - Saint-Hubert 59/7-8

- Outcrop PS 13 (Figs. 2, 3, 5): The outcrop is located in the railway cutting, south of the railway station of Grupont, between 131km280 and 130km691 (only a part of the outcrop is represented in Figure 3). The beds belong to the La Roche, Pernelle and Pesche Formations. The beds, in places highly fossiliferous (e. g. at 130km810), cropping out between 130km888 and 130km691 correspond to the "Grauwacke de Grupont Sg5" or "Assise de Grupont, Sg5" of MAILLIEUX (1940, pp. 4, 20); now they are part of the Pernelle and Pesche (lower part) Formations (see discussion in

GODEFROID & STAINIER, 1982, pp. 144-145, 153-154, tables 1a, b).

- Outcrop PS 14 (Figs. 2, 4): The outcrop is situated between 130km651 and 130km555 [through more precise observations, these measurements differ slightly from those given by GODEFROID (1980, p. 19)], north of PS 13 from which it is separated by a hiatus of 38 m. These highly fossiliferous beds are part of the Pesche Formation (lower part).
- Outcrop PS 15 (Figs. 2, 5): East of the railway cutting, the median part of the Pesche Formation is exposed on the hill-side, along a forest path at the named place "A Cheval Dot".

Systematic palaeontology

Order Spiriferida WAAGEN, 1883
 Suborder Spiriferidina WAAGEN, 1883
 Superfamily Cyrtospiriferoidea
 TERMIER & TERMIER, 1949
 Family Spinocyrtiidae IVANOVA, 1959
 Subfamily Spinocyrtiinae IVANOVA, 1959

Genus *Tenuicostella* MITTMAYER & GEIB, 1967

TYPE SPECIES

Spirifer subcuspidatus var. *tenuicosta* SCUPIN, 1900.

Tenuicostella similis n. sp.

Plate 1, Figures 1-27; Table 1

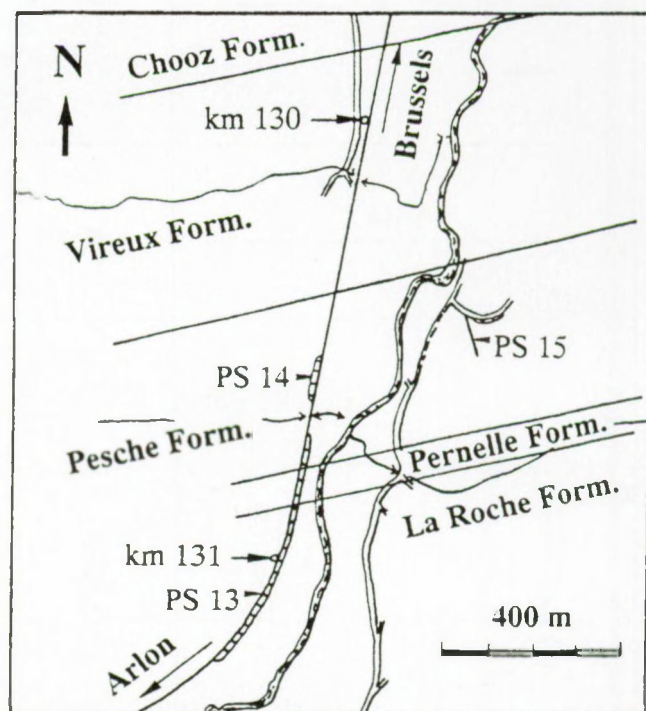


Fig. 2 — Location map with lithological boundaries, of the outcrops PS 13, PS 14 and PS 15 in the Grupont area.

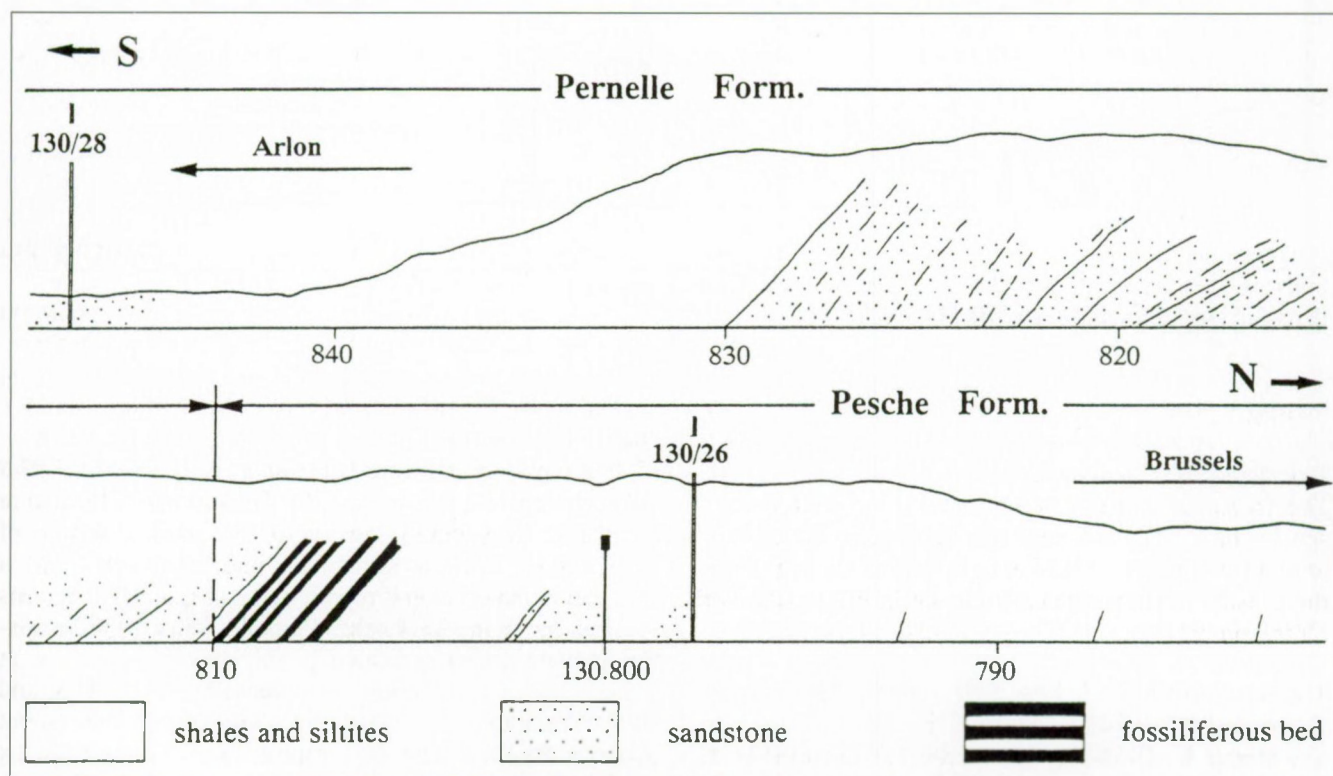


Fig. 3 — Schematic drawing of the northern part of the outcrop PS 13.

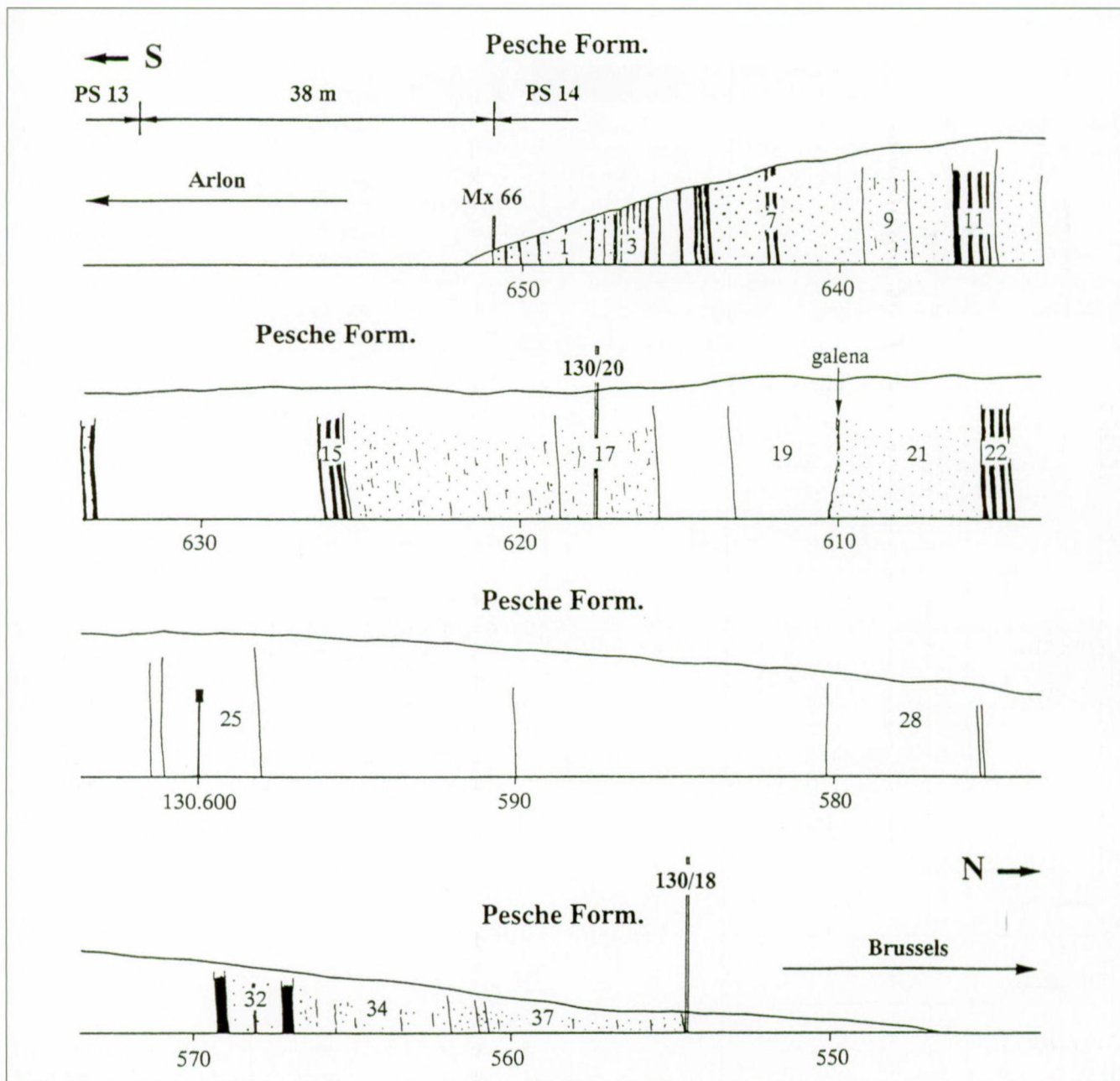


Fig. 4 — Schematic drawing of the outcrop PS 14.

DERIVATIO NOMINIS

Similis, e (lat.): alike, resembling. The species shows a resemblance to *T. tenuicosta*.

TYPES

Holotype: IRScNB a11684 (Pl. 1, Figs. 1-3, 17); Paratypes D: IRScNB a11688 (Pl. 1, Fig. 15); J: IRScNB a11694 (Pl. 1, Figs. 24-27); outcrop PS 14, bed 22.

Paratypes A: IRScNB a11685 (Pl. 1, Figs. 4, 5); B: IRScNB a11686 (Pl. 1, Figs. 6-9); outcrop PS 13, fossiliferous bed located at 130km810.

Paratypes C: IRScNB a11687 (Pl. 1, Figs. 10-14); I: IRScNB a11693 (Pl. 1, Figs. 21-23); Couvin 30 (= JG-1973-1).

Paratypes E: IRScNB a11689 (Pl. 1, Fig. 16); F: IRScNB a11690 (Pl. 1, Fig. 18); outcrop PS 14, bed 8.

Paratypes G: IRScNB a11691 (Pl. 1, Fig. 19); H: IRScNB a11692 (Pl. 1, Fig. 20); outcrop PS 15, bed 3.

Beside the figured specimens, the studied material includes 3 articulated specimens (internal casts), 4 pedicle valves (internal and/or external casts) and 7 brachial valves (internal and/or external casts); some of them are incomplete and/or deformed.

LOCUS TYPICUS

Outcrop PS 14, eastern wall of the railway cutting (Figs. 2, 4, 5). The holotype has been collected in the bed 22 at 130km605.

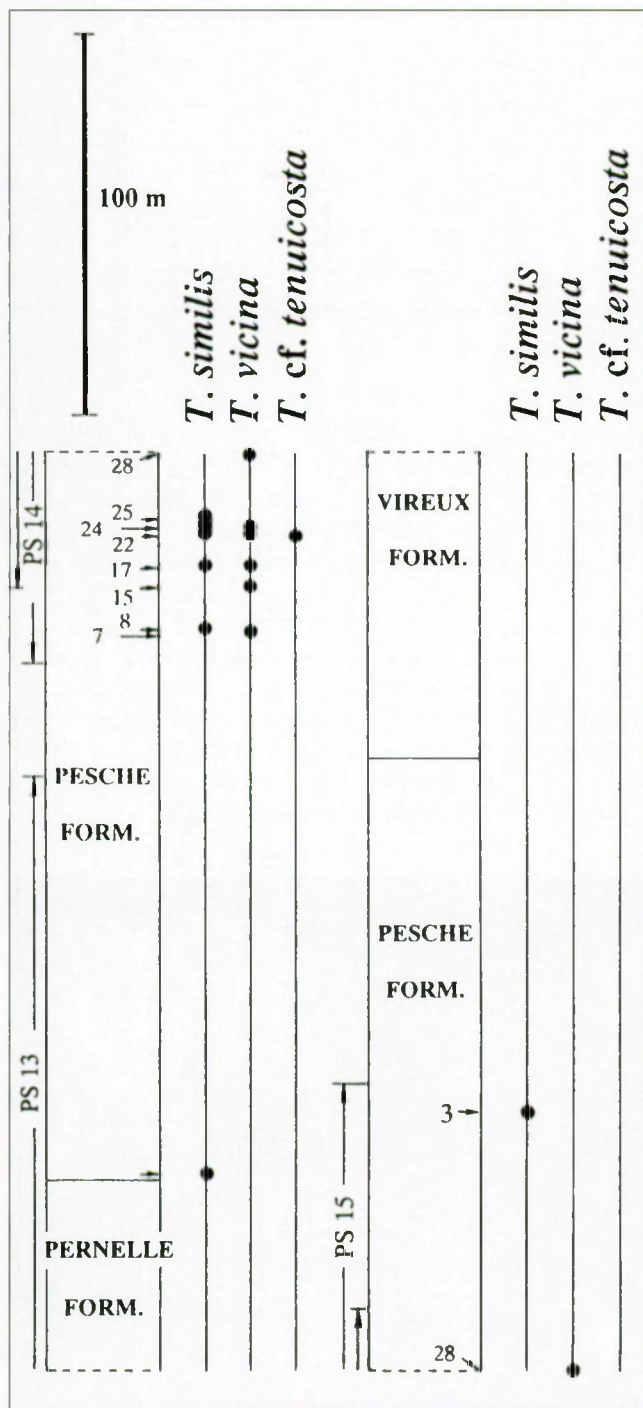


Fig. 5 — Schematic stratigraphic column of the Pernelle (upper part), Pesche and Vireux (lower part) Formations south of Grupont, with distribution of *T. similis*, *T. vicina* and *T. cf. tenuicosta*. Since 1980 (GODEFROID, fig. 12) the boundary between the Pesche and Vireux Formation has been slightly modified through new observations. The position of the fossiliferous beds is indicated in the stratigraphic column.

STRATUM TYPICUM

Pesche Formation (Lower Emsian).

DIAGNOSIS

Middle- to large-sized and moderately wider than long (width/length: 1.4-1.8) *Tenuicostella*. Pedicle valve high, rather dome-shaped than subpyramidal, ± 1.7 times higher than the brachial valve. Interarea clearly curved, apsacline. Shoulder lines concave. Sulcus well delimited, rather deep, with a slightly irregularly curved transverse section. Brachial valve moderately convex. On the shell (external cast), 18-20 costae on each flank; 14-19 on the internal casts. Dental plates moderately thickened posteriorly, weakly curved (bracket-shaped) and slightly diverging. Delthyrial plate and delthyrial callosity in the posterior part of the delthyrial chamber. Muscle field \pm ovate, not or very weakly impressed in the shell wall.

DESCRIPTION

External characters

General characters

The two largest shells are ± 3.2 cm wide and 1.7-2.1 cm large. The width/length ratio varies between 1.4-1.8(?2.0) (to be precised on the basis of more numerous undeformed specimens). The pedicle valve is about 1.4-1.6 times higher than the brachial valve (only 2 specimens measured!). In ventral view, the commissures are regularly curved, except the median part of the anterior commissure which is slightly modified by the depression of the sulcus. The cardinal extremities are pointed (cardinal angles: $\pm 35^\circ$ - 40°), not mucronate.

Pedicle valve

This valve is ± 2.3 -2.9 times wider than high and 1.3-1.9 times longer than thick. The flanks are moderately convex. In lateral view, the valve is arched; its maximum thickness is situated anteriorly to the posterior margin. The shoulder lines, observed on external and internal casts, are concave. The shoulder angle varies between 120° - 132° . The triangular interarea is high, ± 1.3 -1.6 times wider than high, curved and apsacline (in its very basal part, the interarea is almost catacline). The beak overhangs the delthyrium but not the brachial umbo. The sulcus is well defined and rather deep; on most of its length, its section is irregularly rounded (the curvature of the bottom of the sulcus is a little more accentuated than the one of its flanks) but becomes rather regularly rounded near the anterior commissure. At the anterior margin, the width of the sulcus corresponds to 30%-35% of the width of the shell or to the width of the 7-8 adjacent costae. The tongue displays a semi-elliptical outline and is about two times wider than high.

Brachial valve

The brachial valve is low and has a semi-elliptical outline. Its moderately convex flanks become more or less flat close to the cardinal extremities (only observed on

	e.c.	i.c.	Dimensions (cm)							sh.a.
			w.	l.	t.	tp.	tb.	ws.-wf.	n.c.	
Paratype C		*	3.2	2-2.1	1.8	1.1	0.7	1.05	14	132°
Holotype	*	*	3.2	1.8-1.9	/	1.1-1.2	/	1.1	20 e.c.	125°
Paratype B		*	2.7	1.5	/	1.1	/	0.8	18-19	120°
Paratype J		*	2.9	1.6	1.7	1.0	0.7	1.0	14	128°
Paratype D		*	2.8	1.9-2.0	/	1.2	/	1.0	18	120°

Table 1

internal casts!). The fold is low, irregularly rounded or flat topped but without median longitudinal depression.

Ornamentation

On the shell (external cast), the number of costae varies from 18 to 20. The costae are rounded to subrounded and separated by interspaces of the same type. At the anterior margin, there are 7(?) costae on 1 cm on both sides of the sulcus and fold. On the internal casts, the costae are 14-19 in number, less marked than on the shell and appear at variable distances from the posterior margin of the valves.

The growth lamellae seem to be rather regularly spaced (3-5 lamellae on 1 mm); near the anterior margin but also

on more posterior parts of the shell, some of them are strongly imbricate or overlapping (only these well marked growth lamellae are clearly visible on the external casts!). The pseudo-radial microsculpture is made up by capillae (± 9 capillae on 1 mm); spines have not been observed.

Dimensions

The approximate dimensions of 5 specimens are given in Table 1 (e.c. = external cast; i.c. = internal cast; w. = width; l. = length; t. = thickness; tp. = thickness of the pedicle valve; tb. = thickness of the brachial valve; ws. = width of the sulcus; wf. = width of the fold; n.c. = number of costae; sh.a. = shoulder angle).

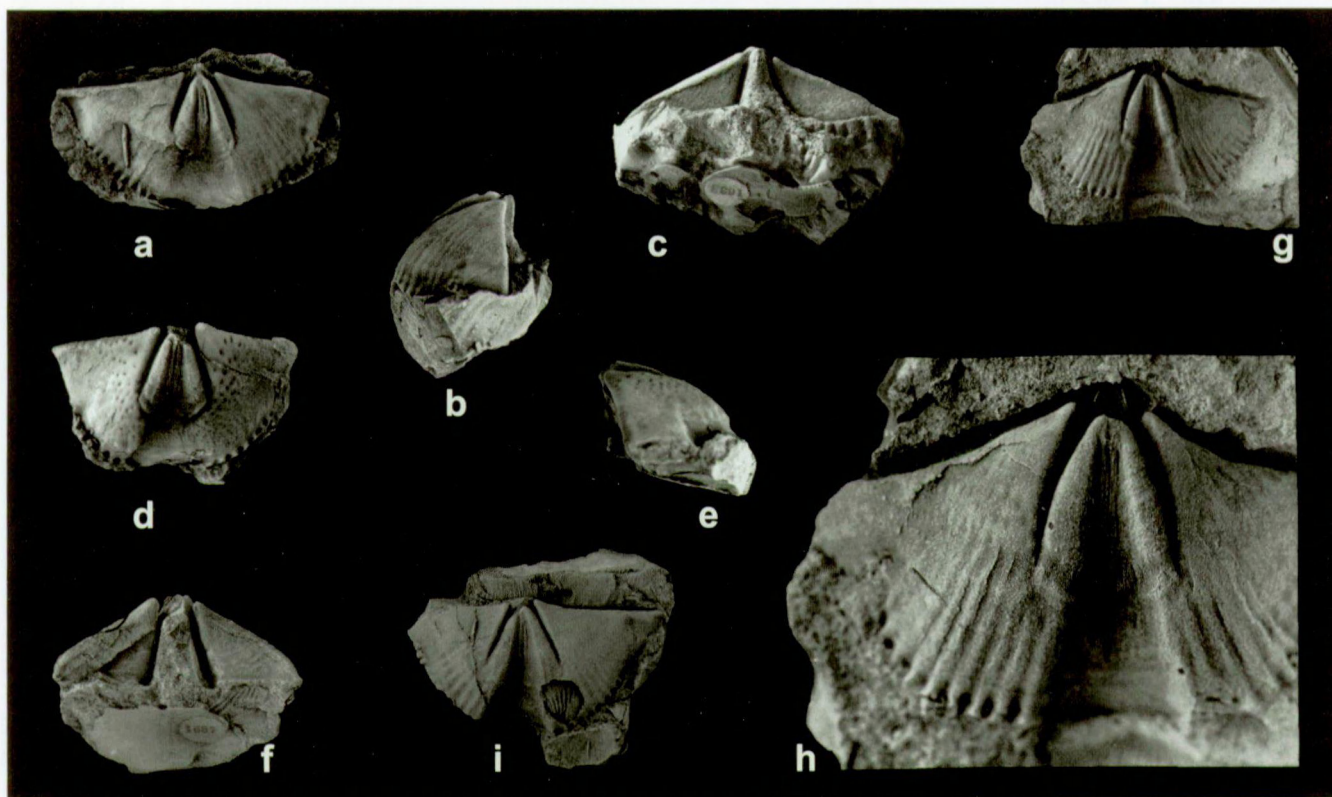


Fig. 6 — a-h: *Tenuicostella tenuicosta* (SCUPIN, 1900); a-c: specimen IRScNB a11695, "Stadtfeld" (old collection), ventral, lateral and posterior views of a pedicle valve (internal cast); d-f: specimen IRScNB a11696, *idem*; g, h: specimen IRScNB a11697, W Oberstadtfeld, internal cast of a pedicle valve displaying the transversal groove corresponding to the delthyrial plate. i: *T. cf. tenuicosta*, specimen IRScNB a11698, *idem*, internal cast of a pedicle valve with wedge-shaped dental plates and transversal groove corresponding to the delthyrial plate but with muscle scars not impressed in the shell wall. a-g, i; natural size; h: X 2.

Internal characters

Pedicle valve

A delthyrial plate is developed, but the cavity delimited by the bottom of the valve and the delthyrial plate (post-delthyrial cavity) is almost entirely filled by a callosity, so that only the very anterior part of the delthyrial plate is free. This anterior free part with an anteriorly concave margin ("arc basal" of VANDERCAMMEN, 1961, p. 3, fig. 1), only observed on casts with their apical part completely preserved, appears as a transversal groove (Pl. 1, Fig. 9) located between the posterior part of the incisions of the dental plates. As in *Subcuspidella* cf. *subcuspidata* (SCHNUR, 1851) (see GODEFROID, 2001, fig. 2), the delthyrial plate is made up by two outgrowths originating on the inner surface of the dental plates and meeting in the plane of symmetry (= "coussinet septal" of VANDERCAMMEN, 1961, p. 11, fig. 6B). On the internal casts, the junction of the two outgrowths is underlined by a moderately marked ridge. The dental plates are moderately thickened posteriorly and slightly curved (bracket-shaped). They diverge from the beak forming an angle of 30°-36°. On the bottom of the valve, their posterior slightly thickened part is located on the third and fourth inner costae and their anterior extremity is situated on the first (or second) inner costa. Their length corresponds to 40%-43% [$\pm 50\%$ in one specimen (Pl. 1, Fig. 15)] of the unrolled length of the valve. The elongate and more or less ovate muscle field (Pl. 1, Figs. 1, 4, 6) is not or only weakly impressed in the shell wall and divided throughout its length by a thin myophragm. Its anteriorly convex margin is underlined by a little marked rounded crest uniting the extremities of the dental plates. The narrow, longitudinally striated adductors are situated in the median part of the muscle field; they are slightly raised

above the lateral part of the muscle field on which only the diductor scars are poorly preserved on some specimens.

Brachial valve

In the brachial valve, the notothyrial platform is divided. Its posterior part is hidden by the cardinal process (ctenophoridium) of which the posterior part is made up by 16-18 thin lamellae. The other characteristics have not been observed.

COMPARISONS

T. similis is close to *T. tenuicosta* of which the specimen figured by SCUPIN [1900, pl. 1 (24), fig. 15a-c], stored in the collections of the "Institut für Paläontologie, Rheinische Friedrich-Wilhelms Universität" at Bonn, has been designated as "Typus" by MAUZ (1935, p. 82) and as "Holotype" by VANDERCAMMEN who refigured the specimen (1967, pp. 4-5, pl. 1, figs. 9, 10). For comparison we have illustrated three specimens of *T. tenuicosta* (Fig. 6a-h) and one of *T. cf. tenuicosta* (Fig. 6i) collected in the Oberstadtfeld area and three others determined *T. cf. tenuicosta* (Pl. 1, Figs. 28-35; Pl. 3, Fig. 7) from the Belgian Lower Emsian. A good illustration of *T. tenuicosta* is also given by SIMON (1953, pl. 6, fig. 2). The main characters distinguishing *T. similis* from *T. tenuicosta* and *T. cf. tenuicosta* are the ventral muscle field and the dental plates. The muscle field is elongate, ovate and not or weakly impressed in the shell wall in *T. similis*; it is wider, \pm subtriangular and with a posterior part impressed in the shell wall in *T. tenuicosta* and *T. cf. tenuicosta* [except in *T. cf. tenuicosta* from Oberstadtfeld (Fig. 6i) of which the wide, subtriangular muscle field is not impressed in the shell wall]. The dental plates are only weakly thickened posteriorly, slightly curved and weakly divergent in *T. similis*; they are well thickened posteriorly, wedge shaped and more widely divergent in *T. tenuicosta* and *T. cf. tenuicosta*. Moreover, it seems that the anterior free edge - and thus the corresponding transversal groove between the posterior parts of the dental plates - of the delthyrial plate is more developed in *T. tenuicosta* and *cf. tenuicosta* than in *T. similis*.

T. dumonti GODEFROID, 2001 has a wider outline than *T. similis*. Its dental plates are thicker posteriorly and its costae are more numerous. There are, however, some specimens of *T. dumonti* (see GODEFROID, 2001, pl. 3, fig. 8) of which the outline and the number of costae are close to those of *T. similis*. The latter species has however a slightly higher pedicle valve, a more inflated umbo, more concave shoulder lines and a less open shoulder angle.

Differences between *T. similis* and *T. vicina* n. sp. will be discussed after the description of the latter species.

By its higher pedicle valve, its more developed pedicle interarea, its longer dental plates, *T. similis* is easily distinguishable from *S. ? humilis*. Good illustrations of this species are given by SCUPIN [1900, pl. 1 (24), fig. 12a, b], SIMON (1953, pl. 6, fig. 1) and VANDERCAMMEN (1967, pl. 1, fig. 11) who refigured the specimen

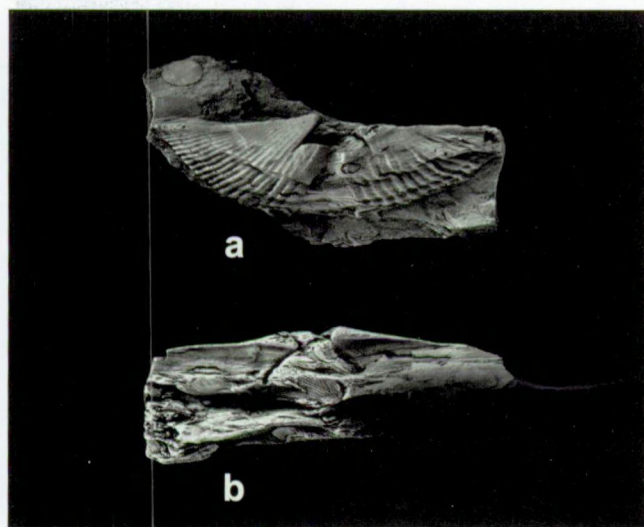


Fig. 7 — *Spirifer subcuspidatus* var. *depressa* FUCHS, 1909. Specimen MB.B. 1325.1, ventral and posterior views of the internal cast figured by FUCHS (1909, pl. 9, figs. 15, 15a).

illustrated by SCUPIN and designated as *Typus* by MAUZ (1935, p. 82).

From *Subcuspidella subcuspidata*, and *S. cf. subcuspidata*, *T. similis* is easily separable by its lower, not subpyramidal pedicle valve, its less developed and differently oriented pedicle interarea.

GEOGRAPHIC AND STRATIGRAPHIC DISTRIBUTION

The species is present in the areas of Couvin [outcrops JG-1972-1 (bed 169) and JG-1973-1] and Grupont (outcrops PS 13, 14, 15). It is known from the La Roche (upper part) and Pesche Formations (Fig. 9).

Tenuicostella vicina n. sp.

Plate 2, Figures 1-28; Plate 3, Figures 1-6; Table 2

DERIVATIO NOMINIS

Vicinus, a, um (lat.): neighbouring. The species occurs with *T. similis*.

TYPES

Holotype: IRScNB a11702 (Pl. 2, Figs. 6, 7); Paratypes A: IRScNB a11703 (Pl. 2, Figs. 1-5); B: IRScNB a11704 (Pl. 2, Figs. 9, 10); C: IRScNB a11705 (Pl. 2, Fig. 8); D: IRScNB a11706 (Pl. 2, Fig. 12); E: IRScNB a11707 (Pl. 2, Figs. 19, 20); F: IRScNB a11708 (Pl. 2, Figs. 24, 25); G: IRScNB a11709 (Pl. 3, Fig. 5); H, I: IRScNB a11710, a11711 (Pl. 3, Fig. 3); J: IRScNB a11712 (Pl. 2, Fig. 28; Pl. 3, Fig. 6); outcrop PS 14, bed 22.

Paratypes K: IRScNB a11713 (Pl. 2, Figs. 22, 23); L: IRScNB a11714 (Pl. 2, Fig. 11); M: IRScNB a11715 (Pl. 3, Figs. 1, 2); N: IRScNB a11716 (Pl. 2, Figs. 26, 27); outcrop PS 14, beds 7, 8, 17, 18.

Paratype O: IRScNB a11717 (Pl. 3, Fig. 4); outcrop PS 15, bed 3.

Paratypes P: IRScNB a11718 (Pl. 2, Fig. 21); Q: IRScNB a11719 (Pl. 2, Fig. 16); R: IRScNB a11720 (Pl. 2, Figs. 17, 18); outcrop JG-1972-1, beds 455, 536.

Paratype S: IRScNB a11721 (Pl. 2, Figs. 13-15); outcrop JG-1973-1, bed 25.

Beside the figured specimens, the studied material includes 9 pedicle valves (internal and/or external casts) and 5 brachial valves (internal and/or external casts); some of these specimens are incomplete and/or deformed.

LOCUS TYPICUS

As for *T. similis*.

STRATUM TYPICUM

Pesche Formation (Lower Emsian).

DIAGNOSIS

Rather large-sized, clearly wider than long (w./l.: 2.3-2.8) *Tenuicostella*. Pedicle valve high, about 1.4-1.5 times higher than brachial valve. Interarea plane or very weakly curved, apsacline. Shoulder lines nearly straight. Sulcus wide, rounded in transverse section. Brachial valve low and moderately convex. On the shell, 19-24 costae on

each flank; on the internal cast, 16-24. Dental plates rectilinear, moderately thickened and widely diverging. Delthyrial plate and delthyrial callosity in the posterior part of the delthyrial chamber. Muscle field subtriangular, as wide as long or slightly wider than long, not or very weakly impressed in the shell wall.

DESCRIPTION

External characters

General characters

The shell is large-sized [the largest but incomplete specimen (Pl. 2, Figs. 1-5) is approximately 5.4 cm wide and 2.0 cm long], ventribiconvex (tp./tb.: ± 1.4 -1.5, only one measured internal cast!) and clearly wider than long (w./l.: 2.3-2.8). Some specimens are deformed but the wider than long outline remains evident. The maximum width is located at the hinge line. In ventral view, the anterior and lateral commissures, laterally to the sulcus, are widely and regularly curved. The cardinal extremities are pointed (cardinal angles of about 45°), not mucronate. The median part of the anterior commissure is only very weakly excavated by the depression of the sulcus.

Pedicle valve

The pedicle valve is moderately thick (w./tp.: 3.3-4.1; l./tp.: 1.3-1.6). The maximum thickness, only observed on internal casts, is located at the posterior end of the muscle field; on the shell, it is probably situated at the beak. The flanks, almost plane or very weakly convex, slope gently in anterolateral direction. In lateral view, the upper surface of the valve, corresponding to the top of the sulcus bounding costae, is nearly straight or feebly arched. Only observed on the internal casts, the shoulder lines, laterally to the incisions of the dental plates, are rectilinear; the wide shoulder angle varies between $\pm 142^\circ$ -153°. The triangular interarea is sharply delimited, steeply apsacline, almost plane or weakly curved and 3.5-3.8 times wider than high. Traces of delthyrial plates have not been observed on the internal casts. The wide and shallow sulcus displays a regularly rounded transverse section; its width at the front corresponds to 25%-33% of the width of the shell or to the width of the 8-10 adjacent costae. The semi-elliptical tongue is about 2 times wider than high.

Brachial valve

The brachial valve is low, 2.2-2.5 times wider than long and with acute cardinal extremities. The low fold has a more or less regularly rounded section throughout its length or displays in its anterior half a flattened or very slightly medially depressed top (but not with a longitudinal groove!). The widening of the fold in anterior direction seems to be irregular and slightly more accentuated in the anterior part than in the posterior so that the fold bounding furrow is not straight but slightly curved.

	e.c.	i.c.	Dimensions (cm)							sh.a.
			w.	l.	t.	tp.	tb.	ws.-wf.	n.c.	
Paratype A		*	(5.4)	1.9-2.0	(2.2)	(1.3)	0.9	1.4	/	153°
Holotype		*	(4.0)	1.5	/	1.1-1.2	/	1.2	24	147°
Paratype B		*	3.5	1.3	/	1.0	/	0.9	21	150°
Paratype C		*	(3.4)	(1.2)	/	0.8-0.9	/	/	/	145°
Paratype H		*	4.9	2.2	/	/	0.5	1.25	22-23	/
Paratype I		*	3.6	1.5	/	/	0.35	0.9	17	/

Table 2

Ornamentation

On the shell (external cast), the costae are subrounded and separated by interspaces of the same type. They start at the posterior end of the valves and their number varies between 19-24 on each flank. Along the anterior margin, there are 8-9 costae on 1 cm on each side of the sulcus and the fold. On the internal casts, the costae are less marked and seem to be rather subangular and locally narrower than on the shell and separated by wider and rounded interspaces. On the internal casts, the 10-12 internal costae become visible only at some distance from the posterior margin; the other, more external costae start at the posterior margin or very slightly anteriorly to it. The more external costae may or may not be marked on the internal casts on which consequently 16 to 24 costae are visible.

The microsculpture (Pl. 3, Fig. 6) is composed of pseudo-radially oriented capillae and growth lamellae. There are 9-10 capillae on 1 mm. As the preservation of the external casts allows \pm accurate observations, the pseudo-radial orientation of the capillae (GOURVENNEC, 1989a, b) is poorly expressed and the capillae look subparallel to the axis of the costae or form with it a very low angle. New capillae seem to appear by bifurcation. Traces of spines have not been observed; on some places of the external casts, through partial abrasion, only the parts of the very thin furrows corresponding to the capillae are preserved close to the anterior margins of the growth lamellae, mimicking bases of spines. Only the slightly imbricate or overlapping growth lamellae are well preserved on the external cast; they are developed at different distances from the posterior margin and mainly close to the front. Fine and tight growth lines seem to occur on the growth lamellae.

Dimensions

The approximate dimensions of 6 specimens are given in Table 2. Brackets mean that the dimension was measured on a deformed or incomplete specimen of which the original shape has been approximately restored. Except for one articulated specimen, all the measured specimens are isolated pedicle (upper part of the table) or brachial (lower part of the table) valves.

Internal characters

Pedicle valve

In the pedicle valve, the posterior part of the delthyrial chamber is partly filled by a delthyrial plate and a callosity; these structures are similar to those observed in *T. similis* (see p. .). The dental plates are rectilinear and moderately thickened. Their length corresponds to 37%-42% of the unrolled length of the valve measured along the sulcus bounding costae. On the bottom of the valve, they are situated on the third costa or the third groove; they diverge from the beak forming an angle of 45° to 50°. The lateral cavities are free and subconical. Between the dental plates, the subtriangular muscle field is not or only weakly impressed in the shell wall. It is as wide as long or slightly wider than long and delimited anteriorly by a very low, arc-shaped ridge (a furrow on the internal casts) uniting the anterior extremities of the dental plates. In some small (young) specimens (Pl. 2, Fig. 28), this ridge is better marked between the dental plates and the sulcus bounding costa than in the sulcus. The muscle impressions are poorly preserved. They are divided on their entire length by a thin myophragm. The narrow and elongated adductors are located in the middle part of the muscle field and are slightly raised above the lateral parts; their anterior end is situated at about the anterior third of the length of the muscle field. Posteriorly to the adductors, the roughly rhombus-shaped impression of the pedicle muscle is more or less marked. Laterally to the adductors, the other muscle scars are barely visible. The teeth have not been observed.

Brachial valve

In the brachial valve, the notothyrial platform is divided; its posterior part is covered by the cardinal process and only the traces of its two anterior parts are visible on the internal casts (Pl. 3, Fig. 2). The posterior part of the cardinal process (ctenophoridium) is made up by 16-18 thin plates or lamellae; in some specimens, the ctenophoridium is divided by a groove more accentuated than those separating the lamellae and located more or less in the plane of symmetry (Pl. 3, Fig. 2). The subconical dental cavities are widely divergent.

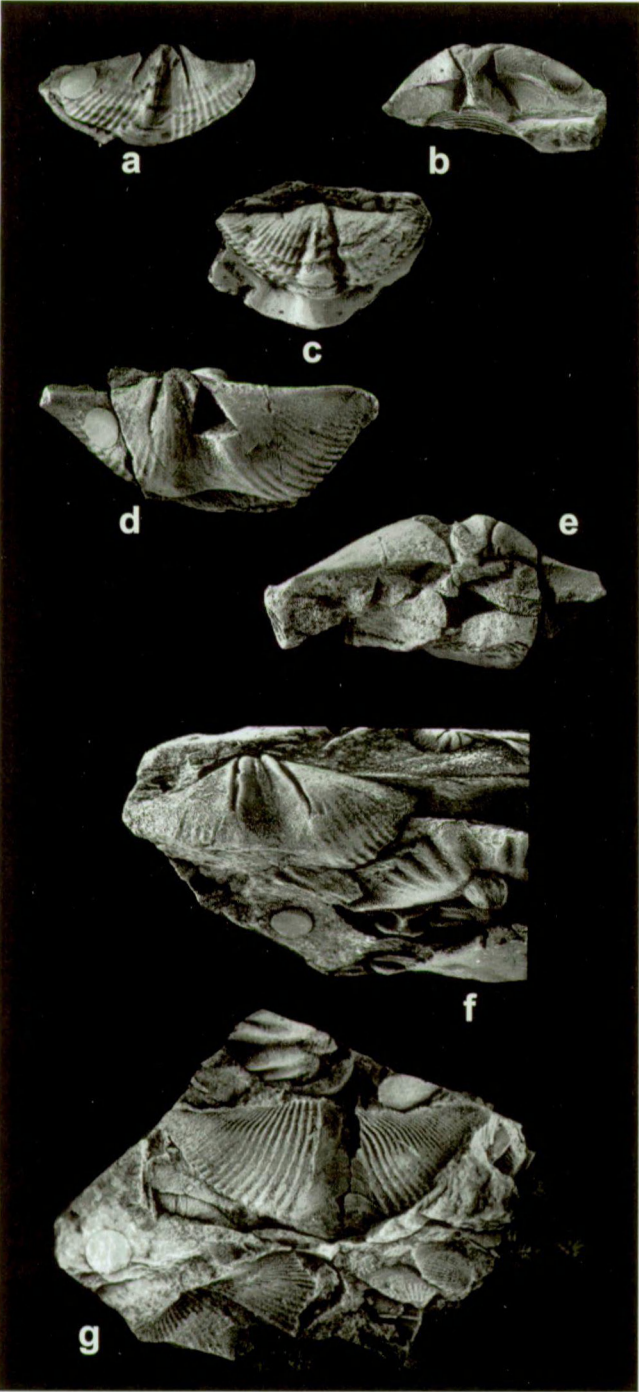


Fig. 8a-c: — *Spirifer incertissimus* n. nom.; a, b: specimen MB.B. 258.1, ventral and posterior views of the internal cast figured by FUCHS (1909, pl. 10, figs. 1, 1a); c: specimen MB.B. 258.2 (Lectotype of “*Spirifer incertus* FUCHS, 1909” designated by MAUZ, 1935), dorsal view of the specimen figured by FUCHS (1909, pl. 10, figs. 2, 2a). d-g: “*Spirifer incertus* FUCHS, 1909” in FUCHS (1915); d, e: specimen MB.B. 259.1, ventral and apical views of the internal cast illustrated by FUCHS (1915, pl. 6, figs. 2, 2a); f: specimen MB.B. 259.4a, ventral view of the internal cast figured by FUCHS (*id.*, pl. 6, fig. 5); g: specimen MB.B. 259.3a, external cast of the specimen figured by FUCHS (*id.*, pl 6, fig. 4) (figured internal cast missing).

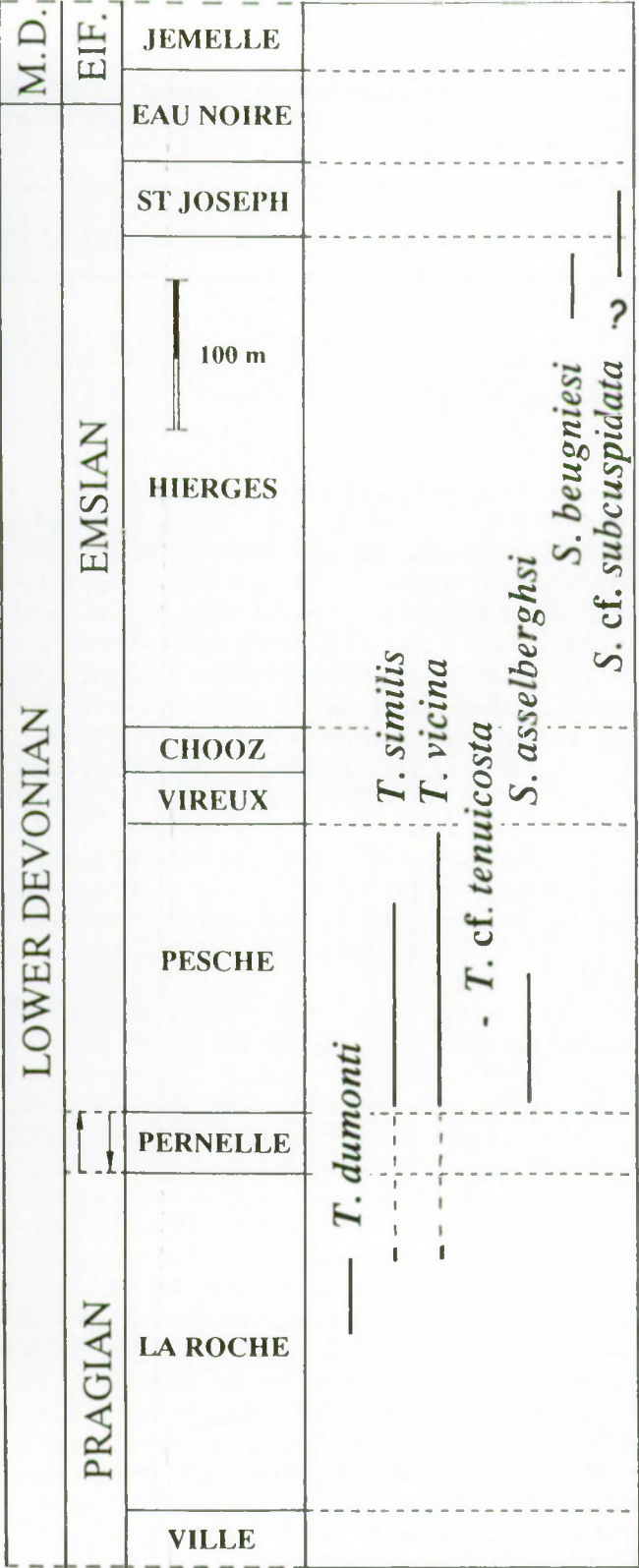


Fig. 9 — Stratigraphic occurrences of species belonging to the genera *Tenuicostella* and *Subcuspidella* described in this paper and by GODEFROID (2001).

COMPARISONS

T. vicina has a wider outline and slightly more numerous costae than *T. similis*. The interarea is \pm plane in *T. vicina* and clearly curved in *T. similis*. The shoulder lines are nearly straight in the first species and concave in the second. The dental plates are straight or nearly so and widely diverging in *T. vicina* and curved (bracket-shaped) and more narrowly divergent in *T. similis*. The outline of the muscle scars in the pedicle valve of the two species is also clearly different.

From *S.?* *humilis*, *S. vicina* is marked off by its larger size, its different outline, its more developed interarea, its more numerous costae and its thicker dental plates.

As *Spirifer subcuspidatus* var. *depressa* FUCHS, 1909, *T. vicina* has a markedly wider than long outline and the same number of costae. The Belgian species differs from the German variety by a higher pedicle valve with, in lateral view, its upper surface (corresponding to the sulcus bounding costae) straight or only weakly curved posteriorly (the pedicle valve of the variety *depressa* is clearly curved longitudinally). The pedicle interarea of *T. vicina* is well developed and more or less plane; the one of *S. subcuspidatus* var. *depressa* is rather low and curved. The specimen figured by FUCHS (1909, pl. 9, figs. 15a, b) is refigured here (Fig. 7) for comparison.

GEOGRAPHIC AND STRATIGRAPHIC DISTRIBUTION

The species has been collected in the La Roche and Pesche Formations (Fig. 9) in the areas of Couvin [outcrops JG-1972-1 (beds 455, 536) and JG-1973-1] and Grupont (outcrops PS 14, 15).

Subcuspidella beugniesi GODEFROID, 2001

2001 – *Subcuspidella beugniesi* n. sp. – GODEFROID, pp. 12-13, 15, pl. 2, figs. 1-21.

REMARK

Characters distinguishing *S. beugniesi* and *S.?* *montana* SPRIESTERSBACH, 1925 have been omitted in the comparisons (GODEFROID, *id.*, p. 15). The Belgian and German species have a very flat brachial valve and about the same number of costae. They differ however from one another by the following characters: interarea generally procline in *S. beugniesi* and catacline (according to the illustrations of SPRIESTERSBACH, 1925, pl. 17, fig. 5c) in *S.?* *montana*; sulcus and fold corresponding to the width of 5-6 costae in *S. beugniesi* and to the width of 9 costae in *S.?* *montana*; fold high in *S. beugniesi* and very flat in *S.?* *montana*; lateral profile of the pedicle valve straight in almost all the specimens of *S. beugniesi* and arched in *S.?* *montana* (on the basis of the original illustrations of SPRIESTERSBACH).

Spirifer incertissimus n. nom.

Figure 8 a-c

non 1858 – *Spirifer incertus* (n. s.) – HALL, p. 602, pl. 3, fig. 3 [= *Tegulocrea incerta* (HALL, 1858)].

? 1899 – *Spirifer micropterus* var. n. *incerta* – FUCHS, pp. 14, 15, 18, 19.

1909 – *Spirifer incertus* n. sp. – FUCHS, p. 63, pl. 10, figs 1, 1a, 2, 2a.

non 1915 – *Spirifer incertus* A. FUCHS – FUCHS, p. 24, pl. 6, figs. 2-5; pl. 18, fig. 4.

REMARK

Spirifer incertus HALL, 1858 (now type species of the genus *Tegulocrea* CARTER, 1992) and *Spirifer incertus* FUCHS, 1909 are primary homonyms. *Spirifer incertus* FUCHS, 1909 is a junior primary homonym and must be renamed. We propose the species-group name *incertissimus*: *Spirifer incertissimus* n. nom.

The name-bearing type of *Spirifer incertissimus* n. nom. remains the one of *Spirifer incertus* FUCHS, 1909 (non HALL, 1858). It is the internal cast of a brachial valve illustrated by FUCHS (1909, pl. 10, fig. 2, 2a) and designated as Lectotypus by MAUZ (1935, p. 83).

The two specimens figured by FUCHS (1909) are from the Remscheider Schichten. They are refigured here (Fig. 8a-c). Later on, FUCHS (1915, pl. 6, figs. 2-5; pl. 18, fig. 4) figured specimens from the “Bornicher Horizont”. Some of these specimens are refigured here (Fig. 8d-g). The specimens illustrated in 1909 are smaller than those figured in 1915. Their outlines are different. The number of costae on each flank is different: 15-16 on the internal casts illustrated in 1909 and 18-24 on the internal and external casts figured in 1915. Moreover the width of the sulcus and fold is equal to the width of 6-7 lateral costae on the specimens of 1909 and to 9 (?10) on the specimens of 1915. For these reasons, we consider that only the specimens of 1909 belong to *Spirifer incertissimus* n. nom. The genus to which this species is assigned is not yet known exactly [according to VANDER-CAMMEN (1963, p. 63), *Spirifer incertus* FUCHS, 1909 belongs to the genus *Spinella* TALENT, 1956]. The specimens of 1915 belong to a different species which must still be named and described precisely.

Tenuicostella similis and *T. vicina* are larger and have a higher pedicle interarea and more numerous costae than *Spirifer incertissimus* n. nom.

From the “*Spirifer incertus*” illustrated by FUCHS (1915), *Tenuicostella similis* is marked off by its higher pedicle interarea and its deeper sulcus.

Tenuicostella vicina with its wide and rather shallow sulcus, its numerous costae and its clearly wider than long outline is close to the “*Spirifer incertus*” figured by FUCHS (1915) from which it is distinguishable by its higher and plane or weakly curved pedicle interarea.

Acknowledgements

M. ABERHAN (Berlin) lent us the type specimens of “*Spirifer incertus* FUCHS, 1909” and *Spirifer subcuspidatus* var. *depressa*. M. SANDERS (Bonn) allowed one of us to study the type specimens of *Spirifer subcuspidatus* var. *tenuicosta* and *S. s.* var. *humilis*. R.B. BLODGETT (Corvallis) and P. CARLS (Braunschweig) reviewed the manuscript and made many valuable suggestions. We are deeply grateful to all these persons.

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Explanations of Plates

Except otherwise indicated, the specimens are figured at natural size.

PLATE 1

Tenuicostella similis n. sp.

- Figs. 1-3, 17 — Holotype, IRScNB a11684. Grupont, outcrop PS 14, bed 22. Pedicle valve. Ventral, lateral and posterior views of the internal cast; artificial mould of the external cast.
- Figs. 4, 5 — Paratype A, IRScNB a11685. Grupont, outcrop PS 13, fossiliferous bed at 130km810. Internal cast of a pedicle valve. Ventral and posterior views.
- Figs. 6-9 — Paratype B, IRScNB a11686. *Idem*. Internal cast of a pedicle valve. Ventral (6, 9), lateral and posterior views. Fig. 9: X 2.
- Figs. 10-14 — Paratype C, IRScNB a11687 (old collection). Couvin 30 (= JG-1973-1). Internal cast of a complete specimen. Ventral, dorsal, lateral, posterior and anterior views.
- Fig. 15 — Paratype D, IRScNB a11688. Grupont, outcrop PS 14, bed 22. Internal cast of a pedicle valve with long dental plates.
- Fig. 16 — Paratype E, IRScNB a11689. Grupont, outcrop PS 14, bed 8. Internal cast of a incomplete pedicle valve, with *Brachyspirifer* (*Torosospirifer*) *crassicosta crassicosta* (SCUPIN, 1900).
- Fig. 18 — Paratype F, IRScNB a11690. *Idem*. Pedicle valve, artificial mould of an external cast.
- Fig. 19 — Paratype G, IRScNB a11691. Grupont, outcrop PS 15, bed 3. Brachial valve, artificial mould of an external cast.
- Fig. 20 — Paratype H, IRScNB a11692. *Idem*. Brachial valve, internal cast.
- Figs. 21-23 — Paratype I, IRScNB a11693 (old collection). Couvin 30 (= JG-1973-1). Ventral, dorsal and posterior views of a deformed articulated specimen (internal cast).
- Figs. 24-27 — Paratype J, IRScNB a11694. Grupont, outcrop PS 14, bed 22. Ventral, lateral, posterior and anterior views of an articulated specimen (internal cast).

Tenuicostella cf. *tenuicosta* (SCUPIN, 1900)

- Figs. 28, 29 — Specimen IRScNB a11699. *Idem*. Ventral and posterior views of an incomplete internal cast of a pedicle valve.
- Figs. 30, 31 — Specimen IRScNB a11700. *Idem*. Ventral and posterior views of an internal cast of a pedicle valve.
- Figs. 32-35 — Specimen IRScNB a11701. *Idem*. Ventral, lateral, anterior and posterior views of an internal cast of a pedicle valve.

PLATE 2

Tenuicostella vicina n. sp.

- Figs. 1-5 — Paratype A, IRScNB a11703. *Idem*. Ventral, dorsal, lateral, posterior and anterior views of an incomplete internal cast.
- Figs. 6, 7 — Holotype, IRScNB a11702. *Idem*. Ventral and posterior views of an internal cast of a pedicle valve.
- Fig. 8 — Paratype C, IRScNB a11705. *Idem*. Pedicle valve, internal cast.
- Figs. 9, 10 — Paratype B, IRScNB a11704. *Idem*. Ventral and posterior views of an internal cast of a pedicle valve.
- Fig. 11 — Paratype L, IRScNB a11714. Grupont, outcrop PS 14, bed 8. Pedicle valve, internal cast.
- Fig. 12 — Paratype D, IRScNB a11706. Grupont, outcrop PS 14, bed 22. Deformed pedicle valve, internal cast.
- Figs. 13-15 — Paratype S, IRScNB a11721. Couvin, outcrop JG-1973-1, bed 25. Ventral, lateral and posterior views of an internal cast of an incomplete pedicle valve.
- Fig. 16 — Paratype Q, IRScNB a11719. Couvin, outcrop JG-1972-1, bed 536. Incomplete pedicle valve, internal cast.
- Figs. 17, 18 — Paratype R, IRScNB a11720 (upper right). *Idem*. Ventral and posterior views of an internal cast of a pedicle valve.
- Figs. 19, 20 — Paratype E, IRScNB a11707. Grupont, outcrop PS 14, bed 22. Ventral and posterior views of an internal cast of a pedicle valve.
- Fig. 21 — Paratype P, IRScNB a11718. Couvin, outcrop JG-1971-2, bed 455. Pedicle valve, internal cast.
- Figs. 22, 23 — Paratype K, IRScNB a11713. Grupont, outcrop PS 14, bed 7. Ventral and posterior views of a juvenile specimen, internal cast.
- Figs. 24, 25 — Paratype F, IRScNB a11708. Grupont, outcrop PS 14, bed 22. Ventral and posterior views of an internal cast of a pedicle valve.
- Figs. 26, 27 — Paratype N, IRScNB a11716. Grupont, outcrop PS 14, bed 25. Ventral and posterior views of an incomplete internal cast of a pedicle valve.
- Fig. 28 — Paratype J, IRScNB a11712. Grupont, outcrop PS 14, bed 22. Pedicle valve of a juvenile specimen, incomplete internal cast.

PLATE 3

Tenuicostella vicina n. sp

- Figs. 1, 2 — Paratype M, IRScNB a11715. Grupont, outcrop PS 14, bed 17. Internal cast of a brachial valve, with, on Figure 1, stropheodontids (upper half), *Euryspirifer dunensis* (KAYSER, 1899) (lower part) and *Arduspirifer* sp. Fig. 2: X 4.
- Fig. 3 — Paratype H, I, IRScNB a11710, a11711. Grupont, outcrop PS 14, bed 22. Internal casts of two brachial valves.
- Fig. 4 — Paratype O, IRScNB a11717. Grupont, outcrop PS 15, bed 3. Internal cast of a brachial valve.
- Fig. 5 — Paratype G, IRScNB a11709. Grupont, outcrop PS 14, bed 22. Incomplete internal cast of a brachial valve, with *Euryspirifer dunensis*.
- Fig. 6 — Paratype J, IRScNB a11712. Grupont, outcrop PS 14, bed 22. Microsculpture observed on the external cast of a pedicle valve (internal cast figured Pl. 2, Fig. 28). X \pm 11.

Tenuicostella cf. *tenuicosta* (SCUPIN, 1900)

- Fig. 7 — Specimen IRScNB a11699. *Idem*. Microsculpture observed on the external cast of a pedicle valve (internal cast figured Pl. 1, Fig. 28, 29). X \pm 10.

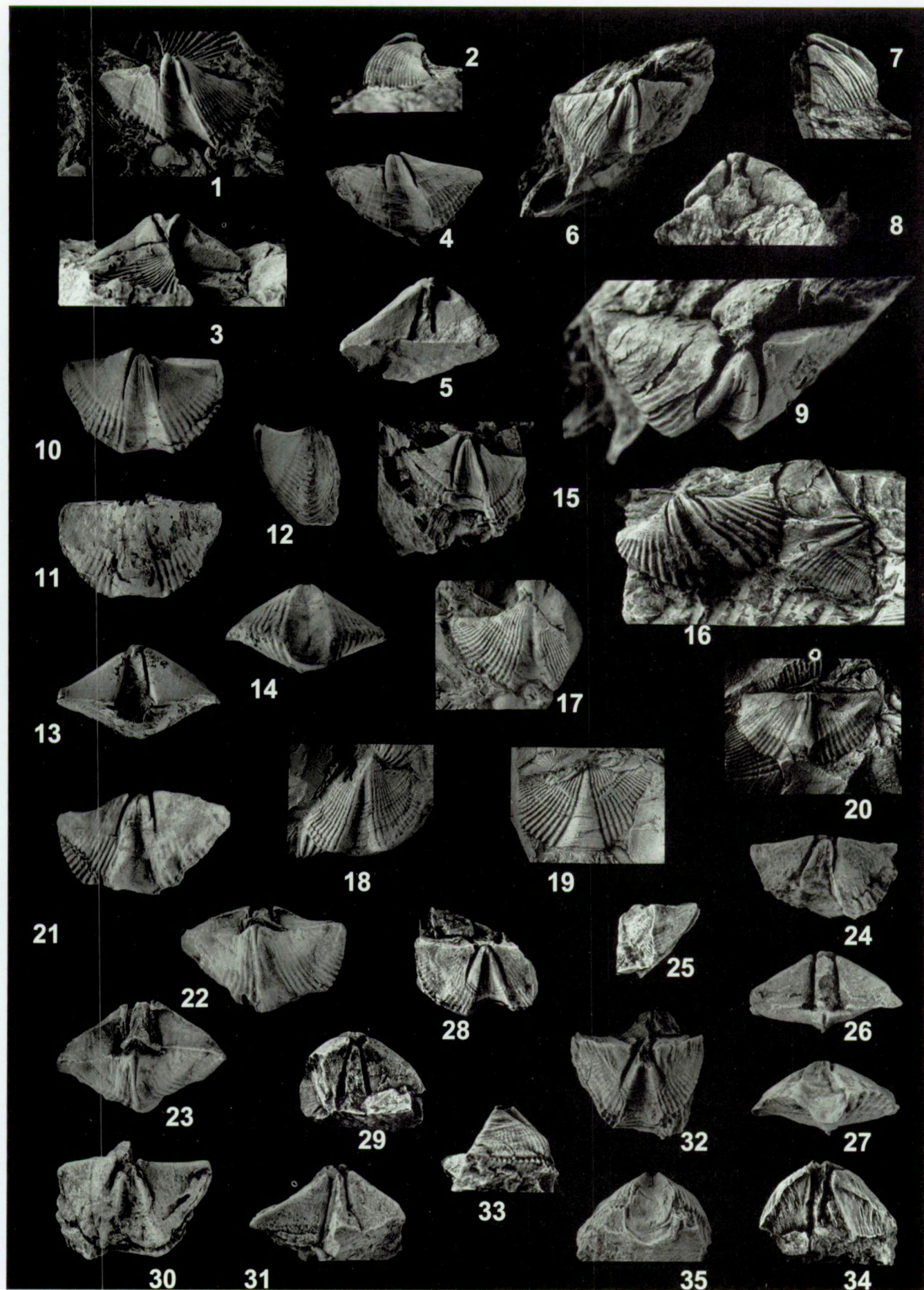


PLATE 1

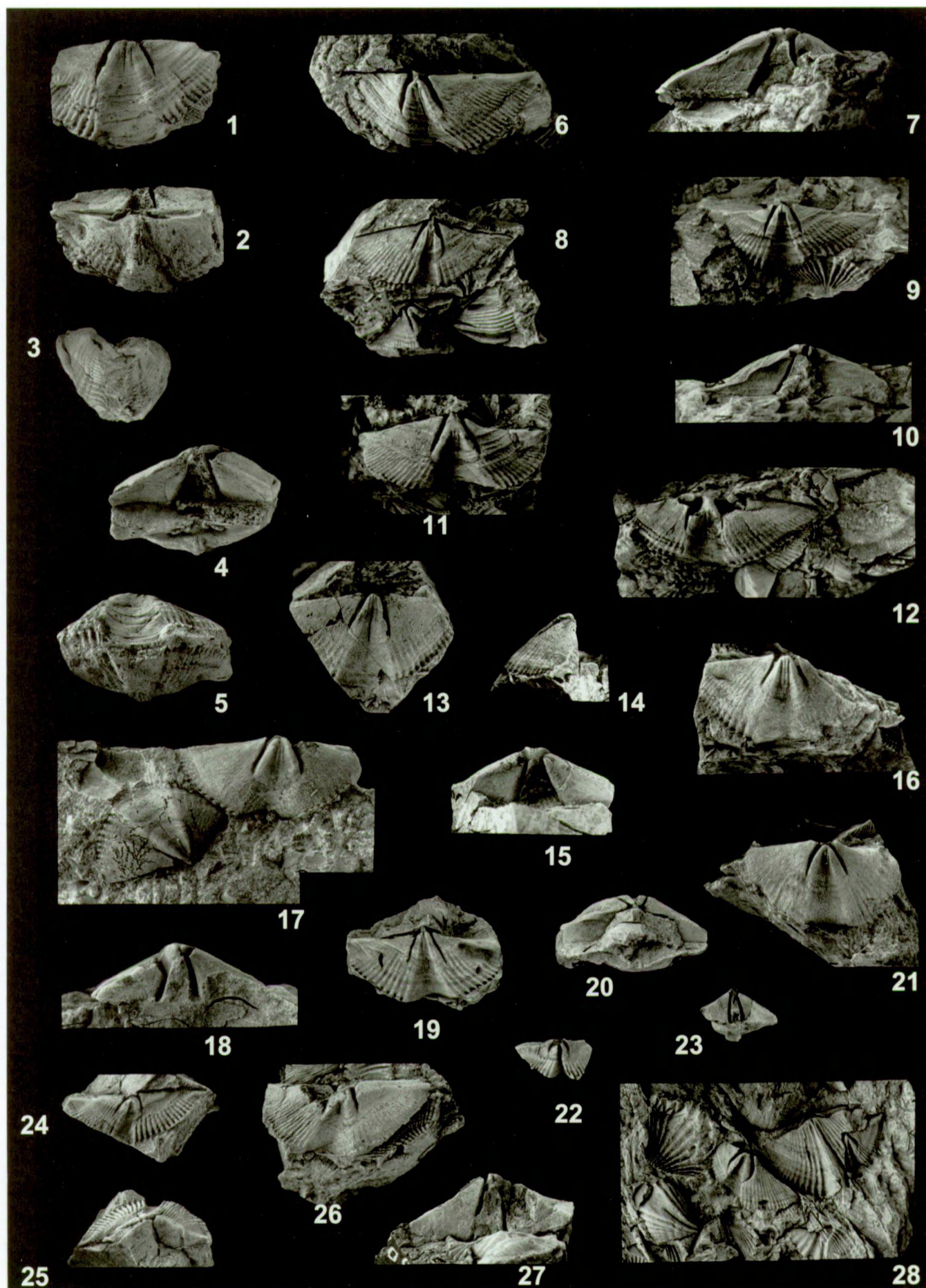


PLATE 2

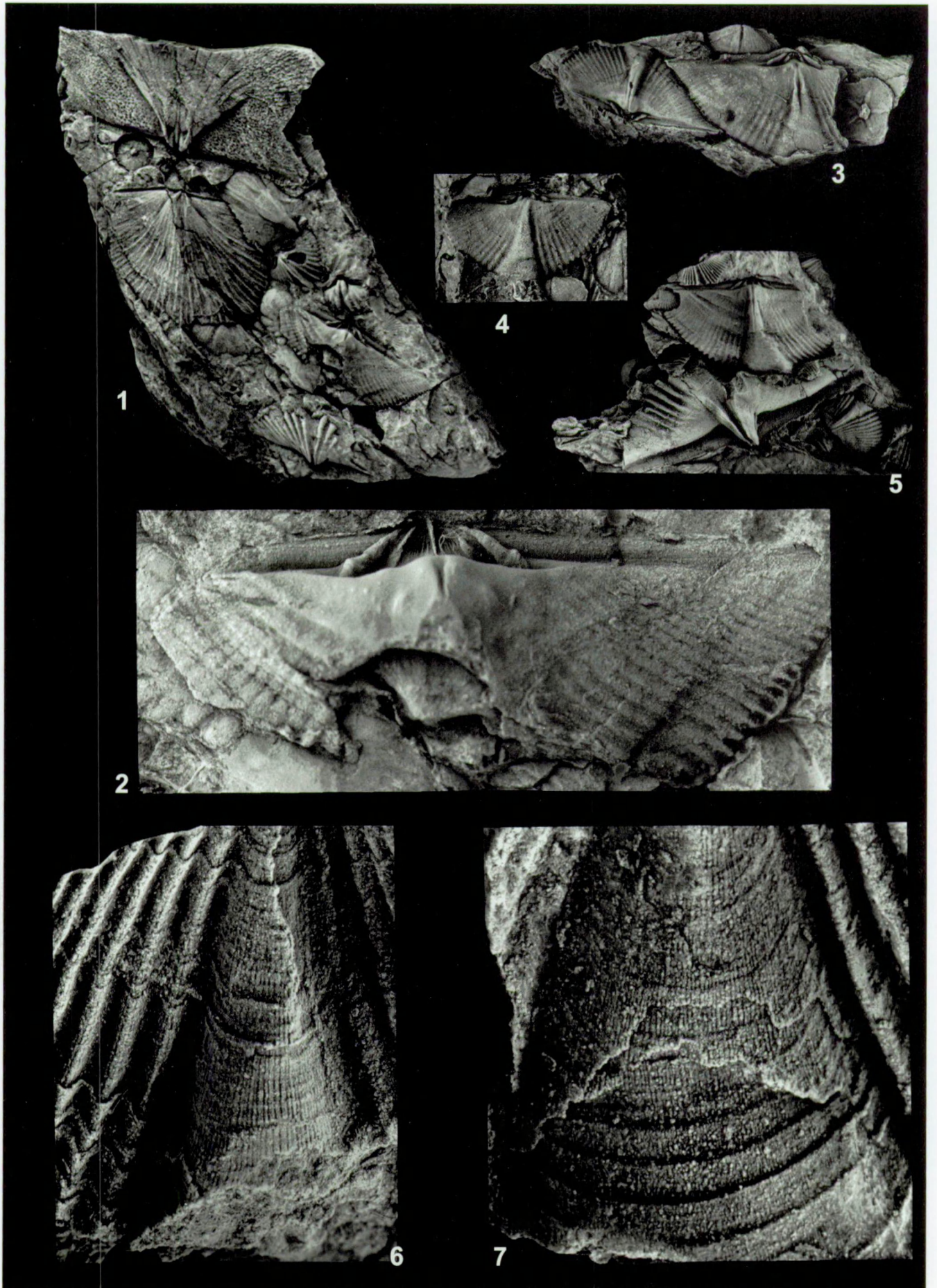


PLATE 3